USAARL Report No. 2011-14

A Novel Application of the Point of Aim Trace Feature for the Engagement Skills Trainer 2000

By Heber Jones
Melody King
Steven Gaydos

United States Army Aeromedical Research Laboratory

Warfighter Performance and Health Division

March 2011

Approved for public release, distribution unlimited.

Notice

Qualified requesters

Qualified requesters may obtain copies from the Defense Technical Information Center (DTIC), Cameron Station, Alexandria, Virginia 22314. Orders will be expedited if placed through the librarian or other person designated to request documents from DTIC.

Change of address

Organizations receiving reports from the U.S. Army Aeromedical Research Laboratory on automatic mailing lists should confirm correct address when corresponding about laboratory reports.

Disposition

Destroy this document when it is no longer needed. Do not return it to the originator.

Disclaimer

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official documentation. Citation of trade names in this report does not constitute an official Department of the Army endorsement or approval of the use of such commercial items.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
15-03-2011	Final	

4. TITLE AND SUBTITLE

A Novel Application of the Point of Aim Trace Feature for the Engagement Skills Trainer 2000

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Heber Jones
Melody King
Steven Gaydos

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army Aeromedical Research Laboratory
P.O. Box 620577
Fort Rucker, AL 36362

8. PERFORMING ORGANIZATION REPORT NUMBER

USAARL 2011-14

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Medical Research and Materiel Command
504 Scott Street
Fort Detrick, MD 21702

10. SPONSOR/MONITOR'S ACRONYM(S)

USAMRMC

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This report outlines a novel data collection technique whereby the standard aim trace (muzzle tracing) feature of the Engagement Skills Trainer 2000 can be captured as a recording, specified over a time interval, and quantified as a root mean square (RMS) distance from the target center of mass. As a research tool, aim trace can represent the dynamic compilation and integration of multiple aspects of the visual-vestibulocochlear-musculoskeletal system of systems as it relates to marksmanship tasks. To this end, it may be of importance to the researcher employing the EST 2000 as a research tool for areas such as Traumatic Brain Injury (TBI) and Soldier return to duty.

15. SUBJECT TERMS

EST 2000, aim trace, marksmanship training, return to duty

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Loraine St. Onge, PhD
UNCLAS	UNCLAS	UNCLAS	SAR	26	19b. TELEPHONE NUMBER *(Include area code)* 334-255-6906

Reset

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

Acknowledgements

The authors would like to express their sincere gratitude to the following people for their contributions to this project:

- Dr. Arthur Estrada for his leadership and mentorship.
- Ms. Elizabeth Stokes for assistance with all matters administrative.
- Mr. Andy Lantz for graphics assistance.
- Ms. Diana Hemphill and Dr. Loraine St. Onge for their invaluable assistance with literature reviews, manuscript editing, and publication requirements.

Table of contents

Page

Introduction 1

Background 3

Development and Implementation Guide 5

Establishing parameters 5

Setup 6

Installing and executing the application 8

Viewing aiming data from the EST device 9

Selecting logging data files for processing 13

Specifying processing parameters 14

Processing 14

Summary 19

References 20

Introduction

I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind…
Lord Kelvin (Sir William Thomson), PLA, vol. 1, "Electrical Units of Measurement," 1883

Basic rifle marksmanship is one of the most fundamental skills required of all Soldiers. Indeed, it is first among the basic Soldier's precept, "Shoot, move, communicate." Essential warriors skills in which all Soldiers must demonstrate competency are listed in the U.S. Army Soldier's Manual of Common Tasks (Department of the Army [DoA], 2008a, 2006). Soldier tasks specifically addressing direct fire marksmanship are outlined in table 1.

Table 1.
Warrior tasks of marksmanship.

Assessment	Warrior Skill Task No.
Engage Targets with an M16 or M4 Series Rifle	071-311-2007 (M16) or 071-100-0003 (M4)
Engage Targets with an M9 Pistol	071-004-0006
Engage Targets with an M240B Machine Gun	071-025-0007
Engage Targets with an M249 Machine Gun	071-010-0006
Engage Targets with an MK19 Machine Gun	071-030-0004
Engage Targets with a Caliber .50 M2 Machine Gun	071-313-3454

The Engagement Skills Trainer (EST) 2000 is a marksmanship training device used extensively throughout the Army to develop, train, and sustain essential individual and collective marksmanship skills (DoA, 2008b). In addition to marksmanship, it is also used to train on squad tactical procedures and friend-foe/shoot-don't shoot judgment and decision scenarios. The EST 2000 has the capability to replicate eleven weapons including rifle, carbine, pistol, various machine guns, grenade launcher, and others (DoA).

The EST 2000 consists of an instructor-operator station, high-resolution projector, detection system, air compressor, projection screen, cabling and hoses to connect to lane position weapon boxes, and the associated training weapons (figure 1). The basic setup includes five firing position lanes. The weapons are slightly modified to interface with the system but still maintain their form, fit, feel, and function (figure 2).

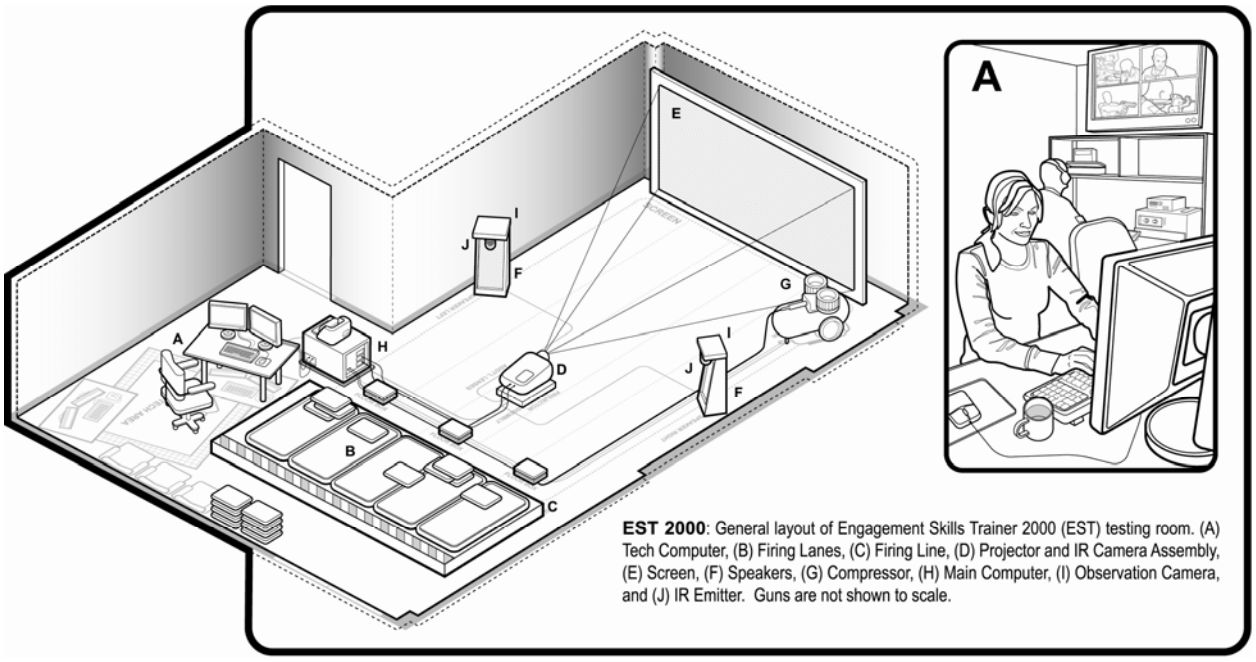


Figure 1. EST 2000 configuration.

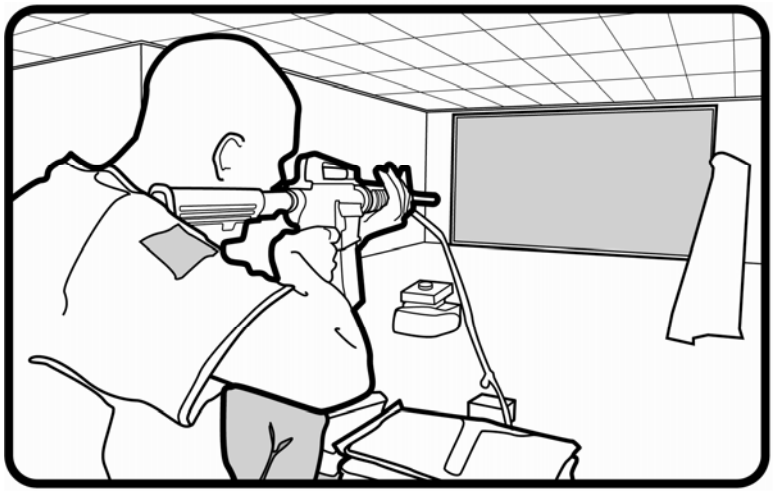


Figure 2. Soldier firing on EST 2000 with M4 rifle.

The EST 2000 possesses the capability to not only record the number of hits and misses, but also to determine shot radius (i.e., accuracy in the form of distance of the shot from center of mass [CM] of the target) and reaction time (i.e., latency of trigger pull from the time of target presentation). Aim trace is another EST 2000 feature important for marksmanship training whereby the point of aim can be displayed before, during, and after the shot to aid in diagnosing problems with aiming, breathing, trigger control, and shot recovery (DoA, 2008b). This technical report outlines a novel data collection technique developed at the U.S. Army Aeromedical Research Laboratory (USAARL) whereby the aim trace feature can be captured as

a recording, specified over a time interval, and quantified as a root mean square (RMS) distance from target CM as a measure of aiming drift. This feature adds to the investigator's armamentarium when employing the EST 2000 as a research tool in studies related to the Warfighter.

Background

The Global War on Terror is almost 10 years old, and our nation's warriors have been engaged in combat operations in multiple theaters of conflict. Tragically, this has resulted in numerous casualties—the majority is blast-related injury. A recent USA Today article discussing traumatic brain injury (TBI) notes that the "signature wound" of the wars in Iraq and Afghanistan is alarmingly prevalent with more than 10 percent (%) of troops sustaining concussion or brain injury and somewhere between 5 and 15% developing long term sequelae (Zoroya, 24 May 2010).

One important challenge for the military leadership is the task of returning these warriors to duty following such an injury. In a May 2009 memorandum to the Secretary of Defense, Admiral M. Mullen, Chairman of the Joint Chiefs of Staff (CJCS), noted that between 5 and 20% of service members have experienced some form of TBI during their deployments ("In-Theater Traumatic Brain Injury Management Memorandum," CJCS, 26 May 2009). He went on to specifically list improved guidance for return to duty (RTD) among his recommendations to improve the management of TBI and minimize the effects of blast exposure.

Within the Army's Medical Research and Materiel Command (MRMC), the Military Operational Research Program (MOMRP) Task Area "P" focuses on RTD for these wounded warriors (MOMRP, 2010). The Task Area mission is to "address the need for research aimed at providing evidence-based criteria for standards to determine the level of operational competence and performance of a Soldier after injury" (Crowley, 2010). Assessing operational competence and true, realistic Soldier performance necessitates assessments that extend beyond the sterile clinic or laboratory setting, often employing Soldier training aids, combat scenarios, and actual warrior skill tasks. To this end, the EST 2000 may prove a very useful vehicle for RTD research.

In addition to scoring target hits and misses, measuring CM accuracy, and capturing trigger reaction time, the EST 2000 employs a simple aim trace feature (sometimes referred to as "muzzle tracing"). With this feature, the point of aim can be displayed before, during, and after the shot (figure 3). Unfortunately, there exists no mechanism within the system with which to record, measure, or otherwise quantify this feature for the purposes of research.

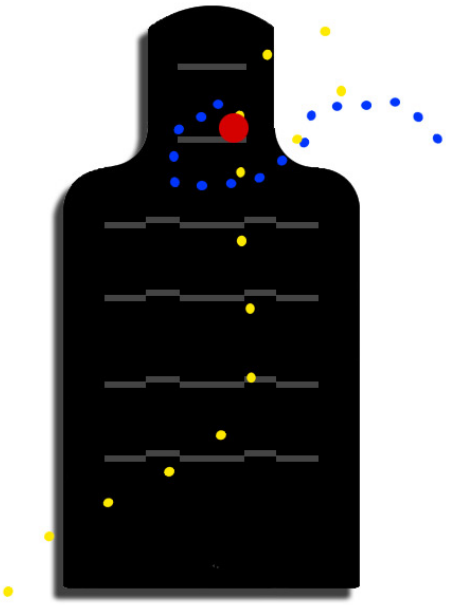


Figure 3. Aim trace feature of the EST 2000. The shot is represented by the red dot.

The aim trace feature became a point of interest for the authors while conducting a drug study employing aspects of the EST 2000 as Soldier task performance metrics (Gaydos, Kelley, Webb, Athy, Walters, et al., 2010). In that study, possible side effects of the test articles (ketamine and morphine) included dizziness, imbalance, vestibular impairment, and other plausible detriments to marksmanship potentially manifesting as aberrant aim traces. Furthermore, it was realized that a refined and quantifiable aim trace feature would be a particularly useful balance, sway, and dynamic postural metric with respect to RTD studies for TBI.

Evidence suggests that no organ in the human body is more sensitive to body acceleration and changes in ambient pressure (e.g., blast) than the vestibulocochlear organs (and their associated central projections) (Lawson & Rupert, 2010). These organs can be considered akin to the "canary in the coal mine" with respect to TBI and the human effects of blast. Blast effects can manifest as damage to the vestibulocochlear end organs, cranial nerve VIII, vascular structures, the brainstem or vestibulocerebellum, cerebral cortex, or the delicate anatomic encasing architecture (e.g., fracture of the temporal bone) (Shumway-Cook, 2007). Aim trace represents the compilation and integration of multiple aspects of the Soldier's visual-vestibulocochlear-musculoskeletal system of systems. To this end, it may be of importance to the researcher employing the EST 2000 as a TBI and RTD research tool.

Development and Implementation Guide

The following steps outline a novel technique developed by the authors utilizing the data of the EST 2000 aim trace feature to derive additional quantitative measures. Researchers can use this technique to determine the quality of the shot and to what extent the path of the aiming point near the shot was smooth and steady. This methods section is written to serve as a stepwise guide for development and implementation.

Establishing parameters

The researcher first chooses the duration of the time interval immediately before the shot to be analyzed. This parameter is labeled "PreShot Time" on the EST Logging Analysis window (figure 4). This time should be comparable to the time required for the marksman to properly squeeze the trigger (finger only; without lateral or vertical force and gradual enough so that the break of the trigger is a surprise). During this time interval, typically one second or less, the researcher can compute how fast the aiming point moves across the target by summing the distances between all consecutive points in the interval and dividing by the time between the first and last points in the interval. In the output field list (table 2), this measure is named "PreShotSpeed." Low values of this measure indicate that the marksman has a steady aim. The researcher can also compute the average of the distance from each of these points to the exact center of the target, named "PreShotRadius" and the square root of the average of the square of these distances, named "PreShotRMS." Low values of these measures indicate that the marksman is on target. The sample standard deviation of the distance to the exact center of the target, named "PreShotSD" can also be computed. Statistically, one can conclude that there is a 68% probability that a surprise shot, as described above, will fall within "PreShotSD" of the mean "PreShotRadius."

Second, the researcher chooses the duration of time interval immediately after the shot to be analyzed. This parameter is labeled "PostShotTime." This time should be less than the time required for the marksman to consciously react to the shot, and is typically a small fraction of a second. During this interval, as with the "PreShotTime" interval, the researcher can compute the speed of the aiming point as the field named "PostShotSpeed" in table 2. A low value of this measure confirms that the marksman's aim was steady, while a high value indicates that he "flinched" or maintained an unstable aim.

Table 2.
Data fields of output file.

	Field	Description
1.	FileName	Name of the data file
2.	Subject	Subject name (e.g., "Subject 07 Ketamine")
3.	Weapon	Weapon type/serial number
4.	Lane	Lane number
5.	Target	Target number
6.	Distance	Distance to target (m)
7.	tReact	Shot reaction time (ms)
8.	OffX	Shot X offset (m)
9.	OffY	Shot Y offset (m)
10.	OffRad	Shot Radius offset (m)
11.	HitMiss	Shot Result string, "Hit/Miss" (user rescore option)
12.	HitRadius	User-defined hit radius (m)
13.	PreShotTime	User-defined time before shot to analyze (ms)
14.	PostShotTime	User-defined time after shot to analyze (ms)
15.	AcqTime	Time from target popup to aiming in outer circle (ms)
16.	PreShotSpeed	Average speed of aiming point in PreShot time (mm/sec)
17.	PreShotRadius	Average radius during PreShot time (m)
18.	PreShotRMS	Square root of the mean square radius in PreShot time (m)
19.	PreShotSD	Standard deviation of radius during PreShot time (m)
20.	PostShotSpeed	Average speed of aiming point in PostShot time (mm/sec)

Setup

The EST 2000 operator enters a name for the scenario and the names of all gunners who will participate along with their assigned lanes and weapons. When the EST 2000 is operated with the “LOG” button (top left on initial screen) on the Toolbar in its default state of “ON” a Shot Data Log file is generated that contains detailed data for all lanes, gunners, targets, and shots. The following legend (table 3) appears at the beginning of each file and shows the types of data that are present:

Table 3.
Legend of a Shot Data Log file.

Event	Data					
START_SCEN	time (ms)					
TARG_PRESENT	time (ms)	lane #	Target #	Target Type	Target Distance (m)	
IMP_PT	time (ms)	lane #	Target #	X Offset (m)	Y Offset (m)	
SENSORS	time (ms)	lane #	Target #	cant (deg)	pitch (deg)	trigger pressure (%)
TRIGGER_PULL	time (ms)	lane #	Target #	React Time (ms)		
SHOT_RESULT	time (ms)	lane #	Target #	X Offset (m)	Y Offset (m)	
END_SCEN	time (ms)					Hit/Miss

The first column above contains the names of events that occur during a scenario. The other columns describe the data columns that are present in the data file for the event named in the first column. Note that each event has a time column, expressed in milliseconds. This is the time elapsed from the start of the scenario (the "START_SCEN" event) until the end of the scenario (the "END_SCEN" event). The impact point event ("IMP_PT") and the "SENSORS" event occur simultaneously approximately 30 times per second, starting when a target pops up (the "TARG_PRESENT" event) and ending after a shot is made (the "SHOT_RESULT" event).

At the completion of the scenario, the EST operator can save the Shot Data Log file with its default unique name (which includes the start date and time of the scenario). This is done on the console by clicking menu item "IOS", then selecting "Backup Timing Study Logs…" and finally browsing to the desired folder. Later, at a convenient time, the EST operator can copy the folders containing the Shot Data Log files to a portable medium that can be imported to a server on a local area network for analysis.

A Visual Studio .NET application named EST was developed by the Information Management/Information Technology (IM/IT) Branch at USAARL to process collections of Shot Data Log files and produce single files suitable for further analysis (e.g., Microsoft Excel, Microsoft Access, SPSS, and other applications). The first line of the output file contains the names of all the fields separated by commas. There are three types of fields:

1. Defined by the operator (in the scenario name or the gunner name);

2. Computed by the EST 2000 device (present in the Shot Data Log file); and

3. Derived by the EST application (from values in the Shot Data Log file).

The remaining lines of the output file contain the data in the fields listed above (table 3).

The Shot Data Log files can be stored in any number of folders with any name, nested up to three levels deep. The user of the EST application specifies criteria for the scenario and gunner names that determine specifically which Shot Data Log files are used to produce the output file.

If the user chooses to re-score the "HitMiss" variable, the application uses the "Bullseye Radius" value that the user enters on the form as the sole criterion to grade each shot. If this new value is different from that output by the EST device, an asterisk is added to the value which becomes "Hit*" or "Miss*".

The "PreShotSpeed" variable is the average speed in mm/sec of the aiming point just before the SHOT_RESULT event. The length of time for this average is specified by the user in the box labeled "PreShot Time" in figure 4.

Installing and executing the application

The application can be installed by any user (computer administrator rights are not required). To install the application (listed on the X: [drive as an example]) double-click the following file:

X:\SCRIPT\VS\EST\SETUP.EXE

This installs and executes the application. To execute the application later, double-click the following shortcut on the START menu:

START\PROGRAMS\USAARL.NET\EST

If the program is executed often, a shortcut copy to the Desktop is advised.

Viewing aiming data from the EST device

The program begins by opening the following window (figure 4):

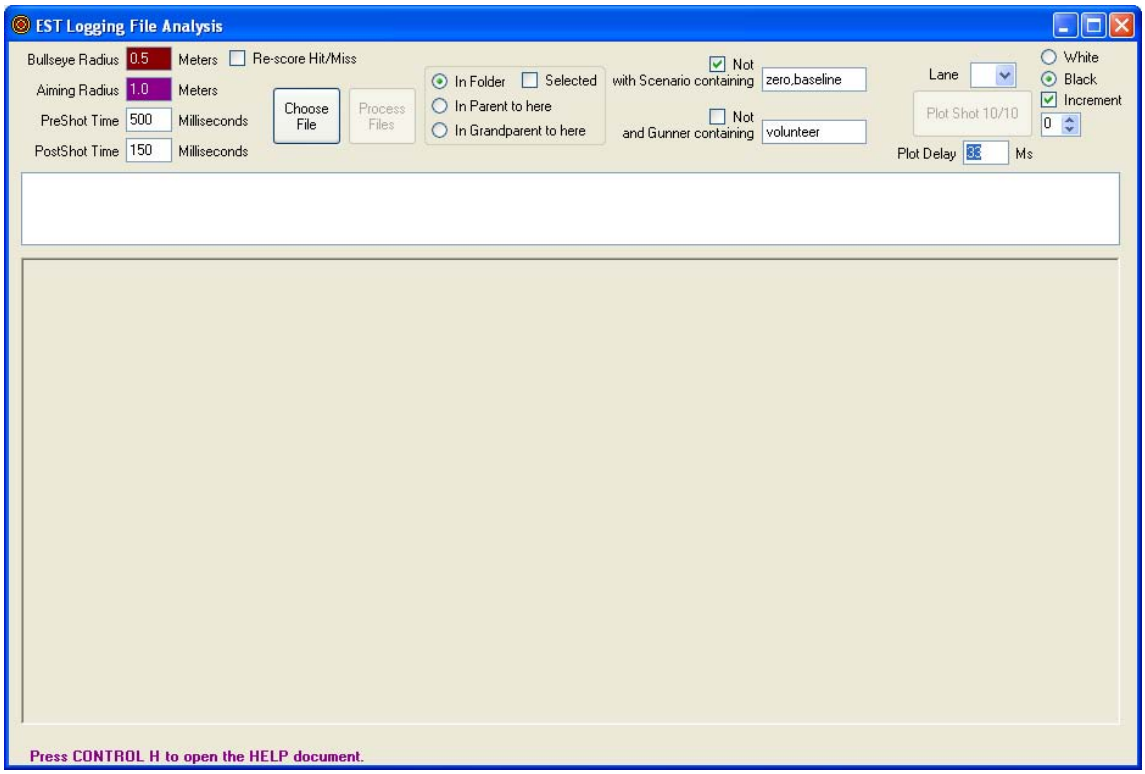


Figure 4. EST logging file analysis.

The “CONTRL-H” key can be used to open the “HELP” document for later reference.
Click the “Choose File” button and select a Shot Data Log file desired for examination, or any file in a folder for processing, as in the following dialog (figure 5):

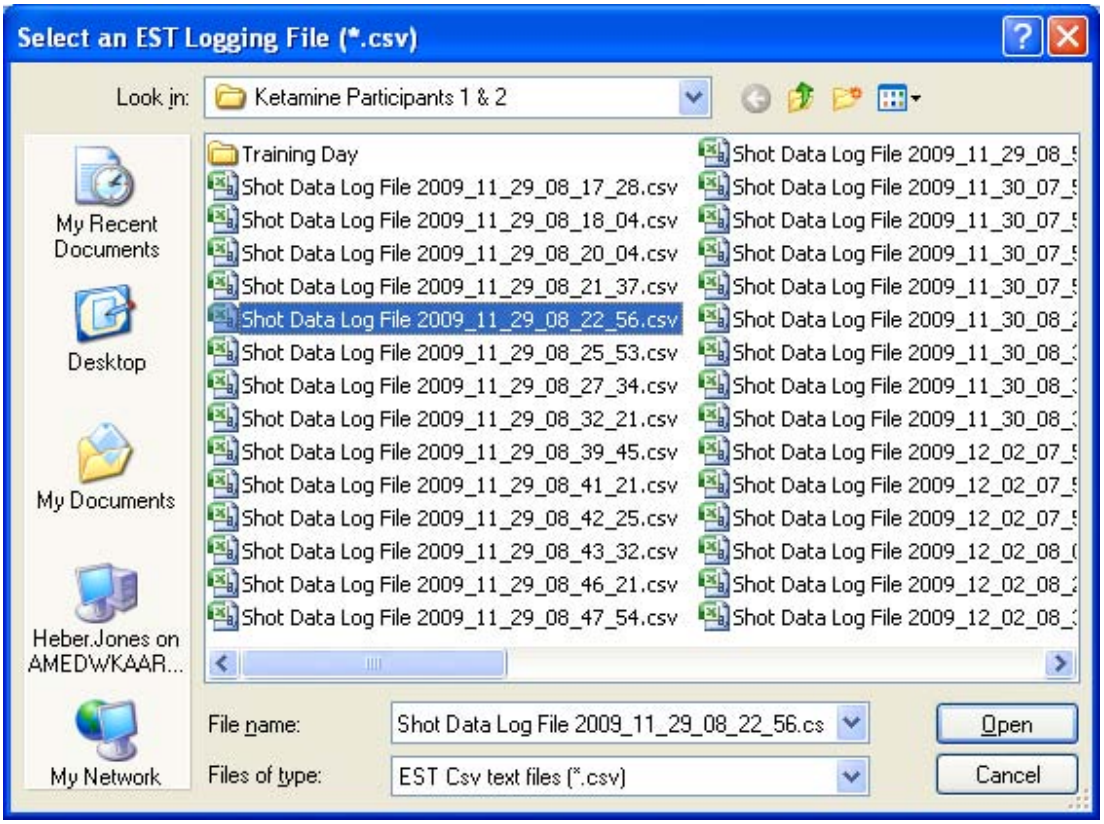


Figure 5. Selecting an EST logging file.

The white listbox now displays the scenario name and the gunner names in this file as shown below (figure 6):

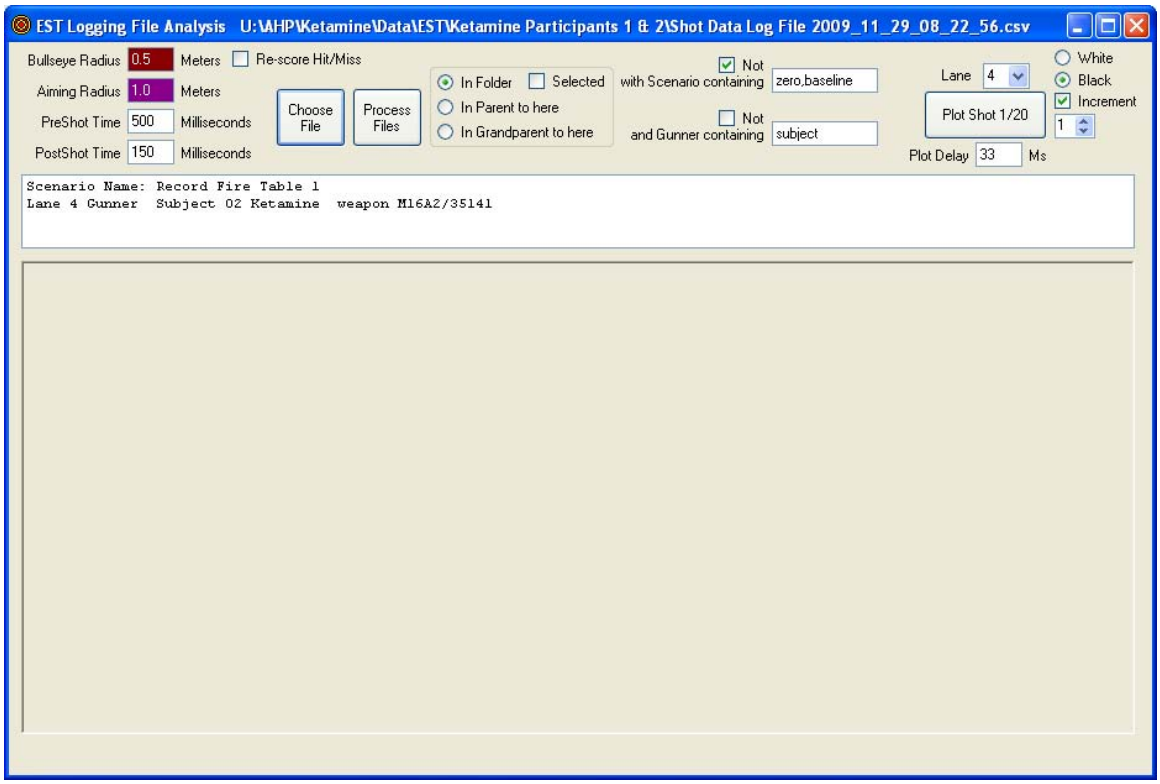


Figure 6. Listbox display of scenario and gunners.

Note that the label on the "Plot Shot" button now shows the number of shots present for the Gunner in the first lane that is used (up to five lanes can be active at the same time). To display the aiming pattern for a shot, first set the "Lane" combo box (if there is more than one gunner). Next, set the up-down control (next to the lower right corner of the "Plot Shot" button) to the desire shot number, and click the "Plot Shot" button. To automatically advance to the next shot after plotting a shot, check the "Increment" box.

To capture a plot for printing (using "ALT-Print Screen"), set the "White" radio button to obtain a white background on the shot plot (saves ink or toner). Next, click the "Plot Shot" button.

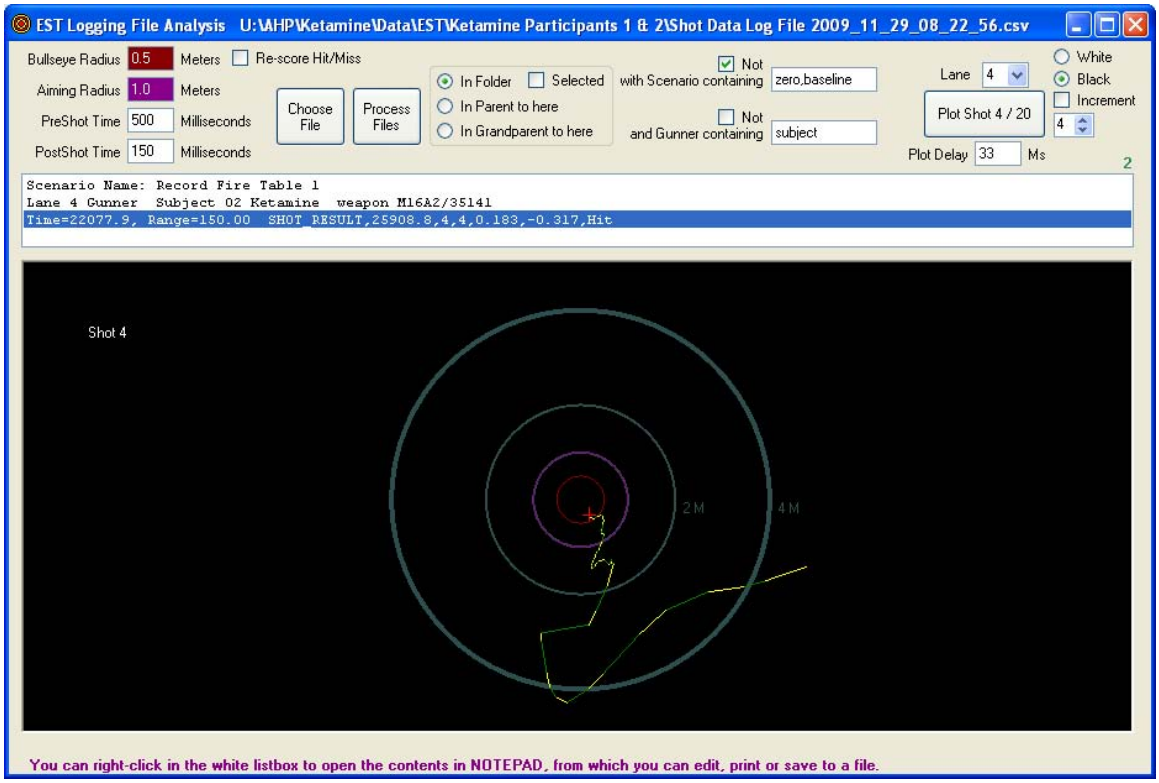


Figure 7. EST plot shot with proper aim technique.

The outer gray circle has a radius of 4 m, and the next inner dark gray circle has a radius of 2 m. The dark magenta circle has a radius equal to the value specified by the user in the "Aiming Radius" textbox (1.0 m in the figure 7 example above). The thin dark red circle has a radius equal to the value specified by the user in the "Bullseye Radius" textbox (0.5 m in the example above).

By default, the aiming line is drawn at the same speed that the aiming point was actually moving across the target; the "Plot Delay" textbox contains the value of 33 ms, matching the sample rate of the EST device. If desired, the lines may be drawn faster by lowering this value. Note that the line changes color at each sample point, making it easy to see the segment length and therefore the speed of the aiming point on each segment. At the time of the "TRIGGER_PULL" event a red line is drawn from the end of the previous line segment to the coordinates indicated on the "SHOT_RESULT" event, where a red "+" is also drawn and a 'beep' sound in generated. The example above (figure 7) shows good aiming technique with rapid approach to the bullseye and slow movement just prior to the shot—an apparent slow deliberate squeeze of the trigger. The example below (figure 8) shows rapid approach to the bullseye and some slow movement near the bullseye, but then rapid acceleration just before the shot—an apparent jerked trigger or flinch.

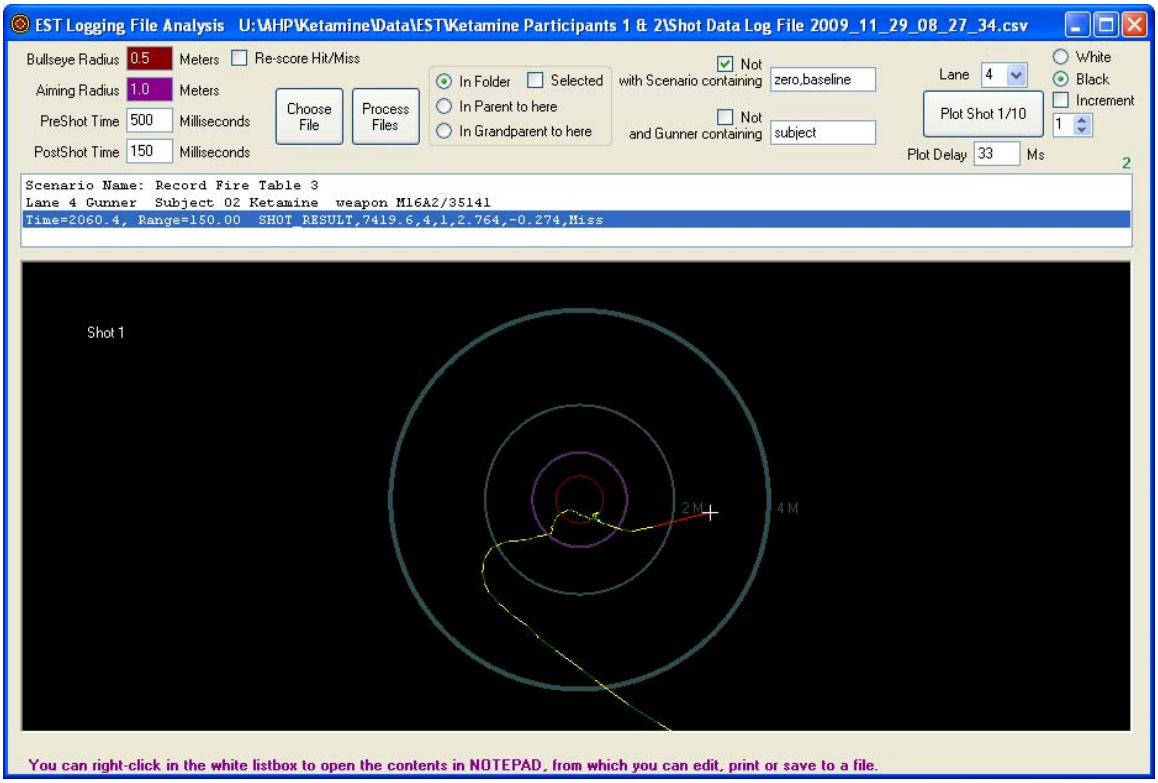


Figure 8. EST plot shot with poor aim technique.

Selecting logging data files for processing

The first step in processing logging data files for subsequent analysis entails selection of the "Choose File" button, and then selecting any file in the *lowest* level folder wished to be included. Next, the options are set in the group box at the top center of the form as follows:

- To process only a few files, click the "In Folder" button and check "Selected" (files will be selected later).

- To process all files in the folder, click the "In Folder" button and uncheck "Selected."

- To process all files in the parent folder and all files in every subfolder of the parent folder, click the "In Parent to here" button.

- To process all files in the grandparent folder, all files in every subfolder of the grandparent folder, and all files in every subfolder of every subfolder of the grandparent folder, click the "In Grandparent to here" button.

Typically, logging data files will include preparatory files with scenario names such as "Quick Zero Confirm – 3 Shot," "9mm 1 sec w-building PRACTICE," or "9mm 1 sec w-building Baseline." These can be excluded from processing by entering a *unique* word from each scenario to be excluded, separated by commas (no spaces) in to the textbox labeled "with scenario containing" *and* checking the "Not" box next to it. For example, to exclude all three of the types of files cited above, enter "zero,practice,baseline" and check the "Not" box.

Logging files may also contain data for extra participants to be excluded from processing. The gunner name for those should not be named as normal participants. For example, normal participants may have gunner names containing the words "Subject" or "Volunteer." To include only gunners with names containing one of these words, enter "subject,volunteer" in the textbox labeled "and Gunner containing," and do not check the "Not" box.

Specifying processing parameters

Enter a value in the textbox labeled "Bullseye Radius" to determine the radius of the thin dark red circle drawn around the center of target clicking the "Plot Shot" button. By checking the box labeled "Re-score Hit/Miss," this value also determines whether a shot is a "Hit*" or a "Miss*." The asterisk is added to indicate when the Hit/Miss determined using this value *disagrees* with the Hit/Miss determined by the EST device.

Enter a value in the textbox labeled "Aiming Radius" to determine the radius of the inner dark magenta circle drawn around the center of target clicking the "Plot Shot" button. Aiming points outside this radius are categorized as "seeking" and those on or inside this radius are categorized as "aiming."

Processing

Click the "Process Files" button after making sure that the controls with the following labels have been set to the proper values:

- Bullseye Radius
  - Re-score Hit/Miss
- Aiming Radius
- PreShot Time
- In Folder
  - Selected
- In Parent to here
- In Grandparent to here
- With Scenario containing
  - Not
- And Gunner containing
  - Not

The following is a typical result from clicking the "Process files" button (figure 9). The first two lines contain some summary results that will help confirm that the correct files were processed. The definitions are:

- AllFiles — Number of files found
- UsedFiles — Number of files processed (met criteria for Scenario and a Gunner)
- AllGunners — Number of Gunners found
- UsedGunners — Number of Gunners used (Gunner name met criteria)
- Targets — Number of targets that popped up for gunners that met criteria
- Shots — Number of shots fired by gunners that met criteria
- ExclScen — Number of Scenarios that did not meet the criteria
- NullFIles — Number of files that did not contain logging data
- ExclGunner — Number of Gunners that did not meet the Gunner name criteria

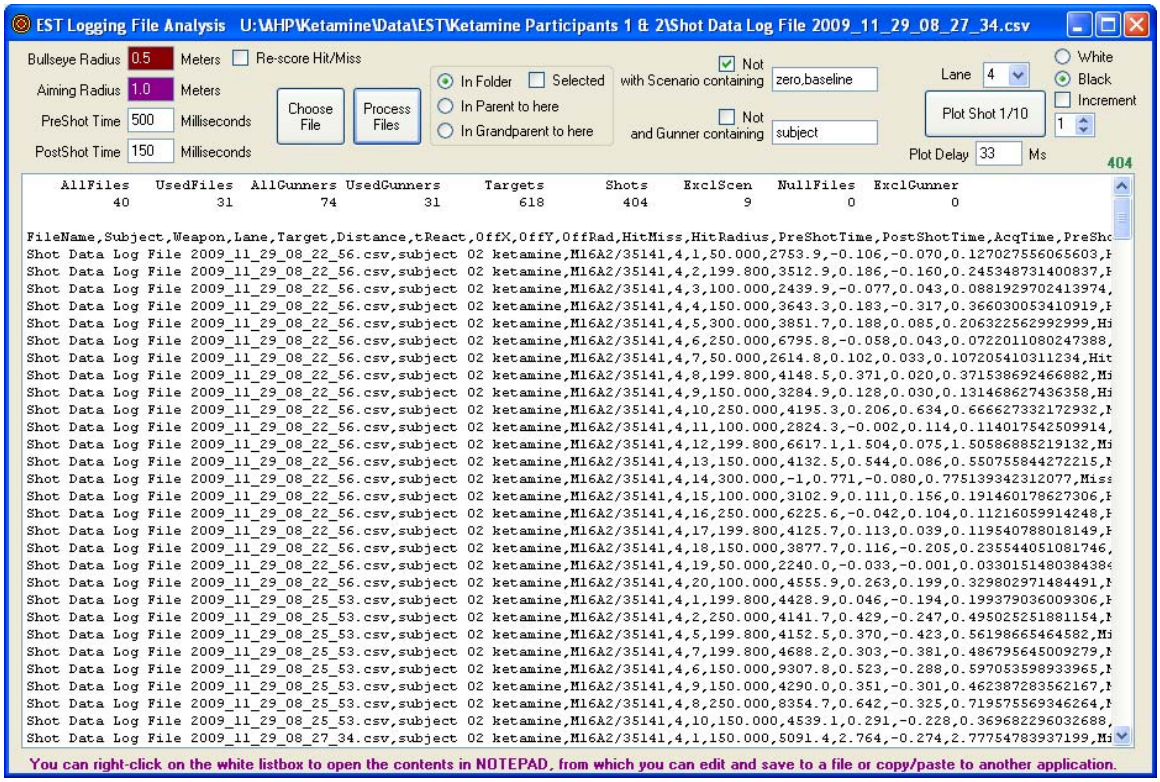


Figure 9. Exporting results to other applications.

To explore these results with another application, right-click the white listbox (figure 9) as suggested by the hint at the bottom of the form and click "YES" to open the contents in "NOTEPAD" and save the contents to a file named "Something.txt." "NOTEPAD" may be required to remove the lines above the field names for some applications. In the example here, Microsoft Excel will be used and no editing is needed.

Open Excel and click the large “Office” button in the upper left corner, then click “OPEN.” In the combo box with the label “Files of type,” select “Text Files” (*.prn;*.txt;*.csv). Navigate to and select the file saved from “NOTEPAD.” The Text Import Wizard will open. In step 1, select “Delimited” and start the import at row 7 as shown below (figure 10):

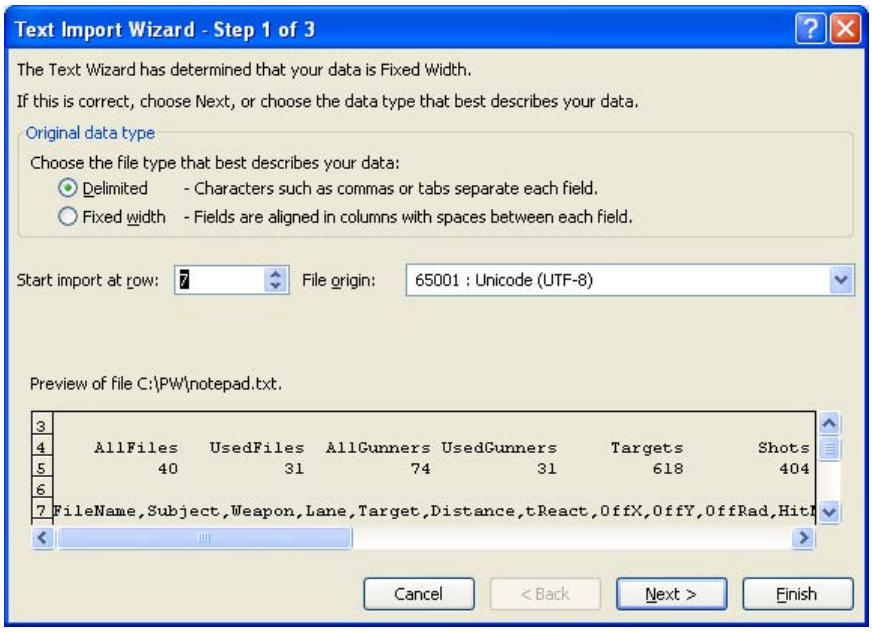


Figure 10. Text import wizard, step 1.

Click “Next” to go to step 2. On step 2, select the comma delimiter as shown below (figure 11):

Figure 11. Text import wizard, step 2.

Finally, click “Finish” to see the spreadsheet below (figure 12):

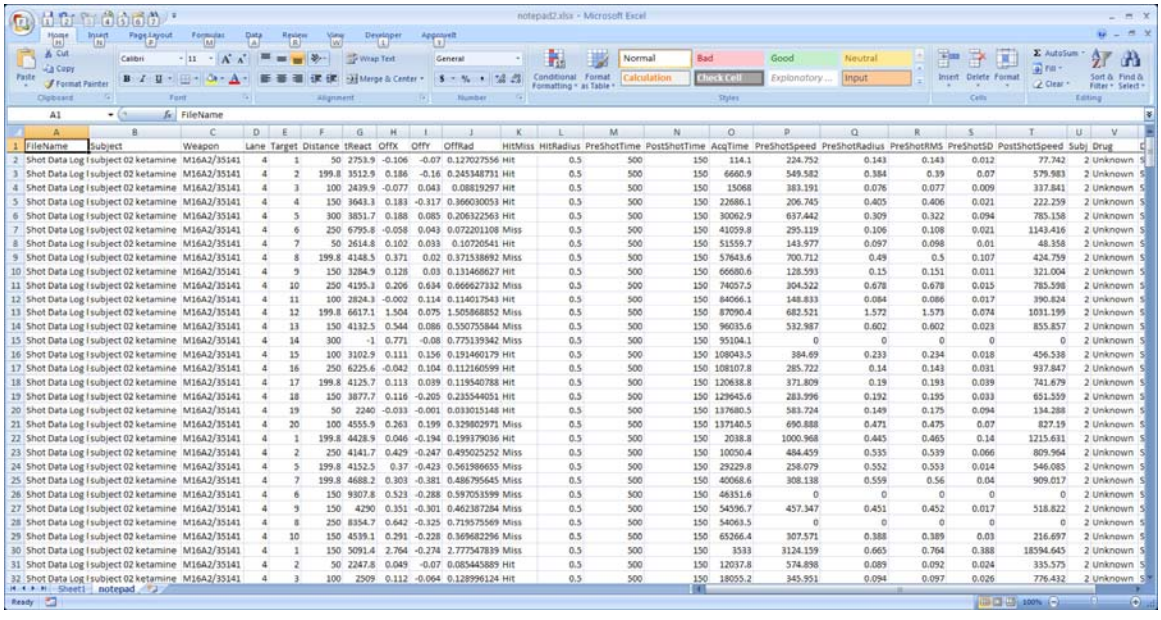
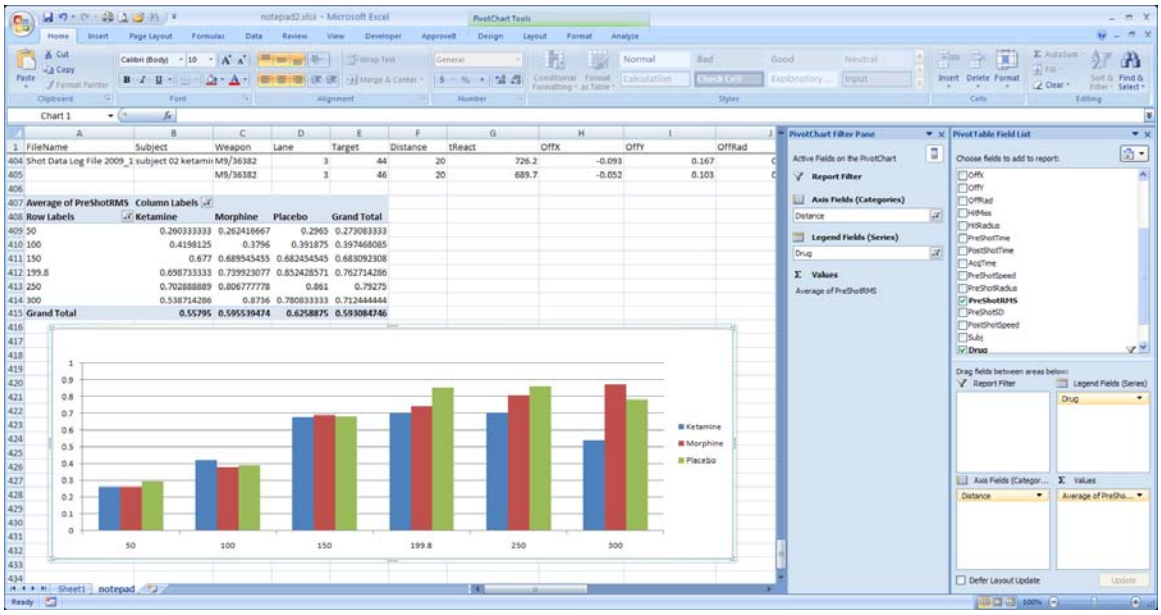


Figure 12. Exporting results to spreadsheet.

One of the tools in Excel that can easily be used to analyze data is the pivot chart, like the sample shown below (figure 13):



FileName	Subject	Weapon	Lane	Target	Distance	tReact	OffX	OffY	OffRad
Shot Data Log File 2009_1	subject 02 ketamir	M9/36382	3	44	20	726.2	-0.093	0.167	
		M9/36382	3	46	20	689.7	-0.052	0.103	

Average of PreShotRMS	Column Labels			
Row Labels	Ketamine	Morphine	Placebo	Grand Total
50	0.260333333	0.262416667	0.2965	0.273083333
100	0.4198125	0.3796	0.391875	0.397468085
150	0.677	0.689545455	0.682454545	0.683092308
199.8	0.698733333	0.739923077	0.852428571	0.762714286
250	0.702888889	0.806777778	0.861	0.79275
300	0.538714286	0.8716	0.780833333	0.712444444
Grand Total	0.55795	0.595539474	0.6258875	0.593084746

Figure 13. Manipulating results in spreadsheet.

Summary

This report outlines a novel data collection technique whereby the standard aim trace (muzzle tracing) feature of the EST 2000 can be captured as a recording, specified over a time interval, and quantified as a RMS distance from the target CM. This technique is useful as a quantifiable measure to assess tenets of basic rifle marksmanship (e.g., contrasting figures 7 and 8).

Furthermore, when employing the EST 2000 as a research tool, the aim trace application can also represent the dynamic compilation and integration of multiple aspects of the Soldier's visual-vestibulocochlear-musculoskeletal systems as it applies to marksmanship tasks. To this end, it may be of importance to the researcher employing the EST 2000 as a research tool for areas such as TBI and Soldier RTD.

References

Anthony, D. 2006. EST 2000: Engagement Skills Trainer. Orlando, FL: Cubic Defense Application.

Crowley, J. S. 16 Feb 10. "Develop return-to-duty standards and strategies" presented at the Research Task Area P Steering Committee Meeting, Fort Rucker, AL.

Department of the Army. 2006. Soldier's manual of common tasks, warrior skills level 1. Soldier Training Publication No. 21-1-SMCT. Washington, D.C.

Department of the Army. 2008a. Soldier's manual of common tasks, warrior leader skills levels 2, 3, and 4. Soldier Training Publication No. 21-24-SMCT. Washington, D.C.

Department of the Army. 2008b. Rifle marksmanship: M16-/M4-series weapons. Field Manual 3-22.0. Washington, D.C.

Gaydos, S. J., Kelley, A. M., Webb, C. M., Athy, J. R., Walters, P. L., et al. 2010. Comparison of the effects of Ketamine and Morphine on the performance of representative military tasks. Fort Rucker, AL: U.S. Army Aeromedical Research Laboratory. USAARL Report 2010-17.

Lawson, B. D., and Rupert, A. H. 16-18 Jun 10. Vestibular aspects of head injury and recommendations for evaluation and rehabilitation following exposure to severe changes in head velocity or ambient pressure. Proceedings of the International Conference on Human Performance at Sea, University of Strathclyde, Glasgow, U.K.

Military Operational Medicine Research Program (MOMRP). 26 Oct 10. https://momrp.amedd.army.mil/index.html#.

Shumway-Cook, A. 2007. Assessment and management of the patient with traumatic brain injury and vestibular dysfunction. In Herdman, S. J. (Ed.), Vestibular Rehabilitation, Third Edition. Philadelphia, PA: F.A. Davis Company.

Zoroya, G. 24 May10. Two wars produce unique and puzzling brain injuries. USA Today.

Department of the Army
U.S. Army Aeromedical Research Laboratory
Fort Rucker, Alabama, 36362-0577
www.usaarl.army.mil

U.S. Army Medical Research and Materiel Command